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(54) **Document creation aid**

(57) A document creation aid 1 is provided which can automatically generate various types of layouts with attribute boxes from documents whose layouts serve as models for the layouts. The aid defines regions which are different from one another in accordance with attributes (e.g. text, tables, pictorial) of images included in the document and processes each of the regions differently. The aid includes an image input section 2 for reading an image of the document serving as a model. A layout analysis section 3 detects attributes of the images read from the document and identifies layout data indicating the size, position, and attribute of each of the regions based on differences in the judged attributes. A layout generating instruction section 4 sets the same regions as those of the document serving as a model for a document to be created based on the identified layout data.

FIG. 1

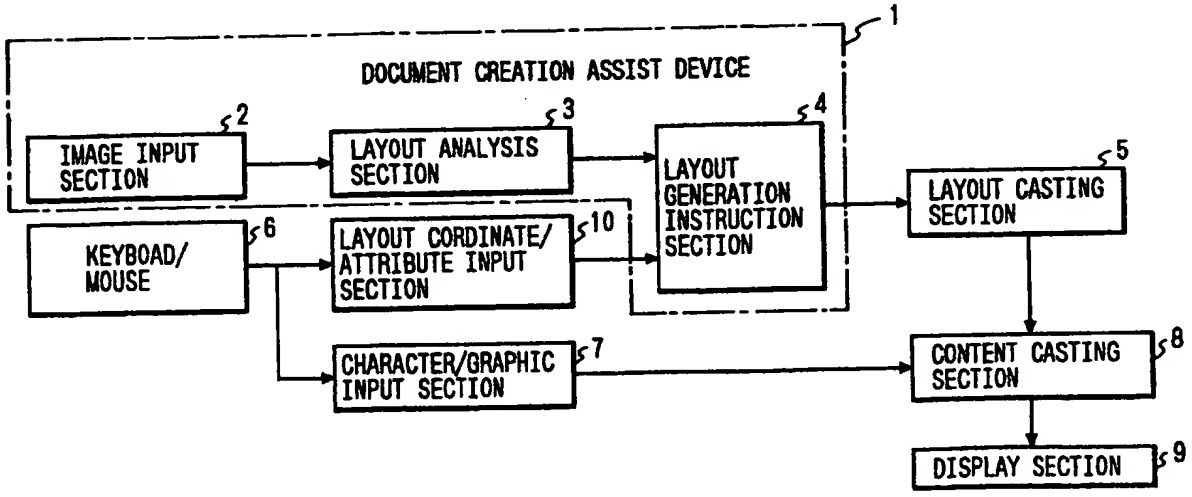

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FIG. 1

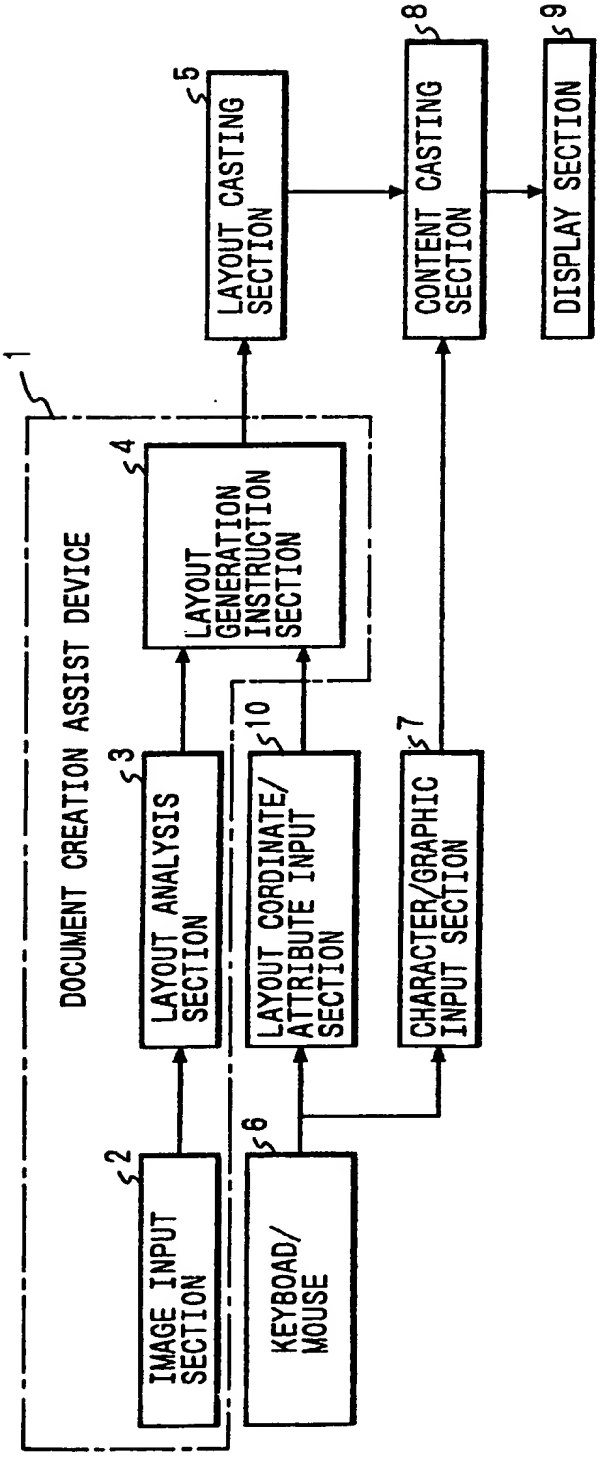

DOCUMENT CREATION ASSIST DEVICE
1
IMAGE INPUT SECTION
2
LAYOUT ANALYSIS SECTION
3
LAYOUT GENERATION INSTRUCTION SECTION
4
LAYOUT CASTING SECTION
5
KEYBOAD/ MOUSE
6
CHARACTER/GRAPHIC INPUT SECTION
7
CONTENT CASTING SECTION
8
DISPLAY SECTION
9
LAYOUT CORDINATE/ ATTRIBUTE INPUT SECTION
10

FIG. 2

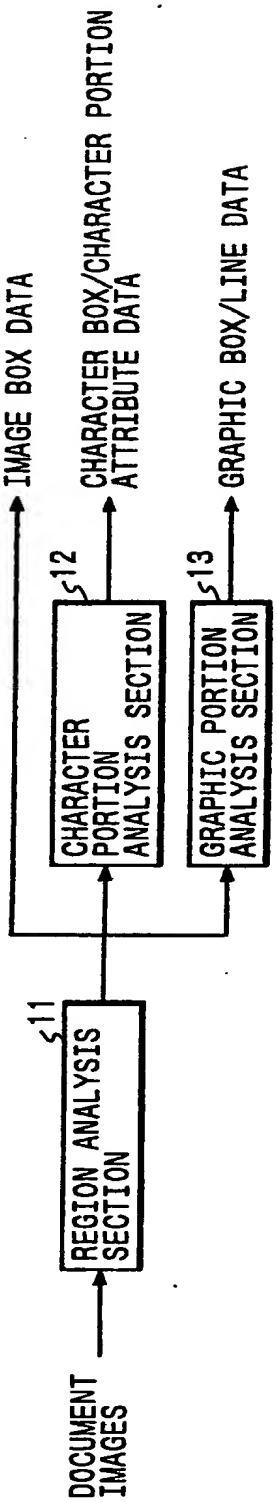

DOCUMENT IMAGES
11
REGION ANALYSIS SECTION
12
CHARACTER PORTION ANALYSIS SECTION
13
GRAPHIC PORTION ANALYSIS SECTION
IMAGE BOX DATA
CHARACTER BOX/CHARACTER PORTION ATTRIBUTE DATA
GRAPHIC BOX/LINE DATA

FIG. 3

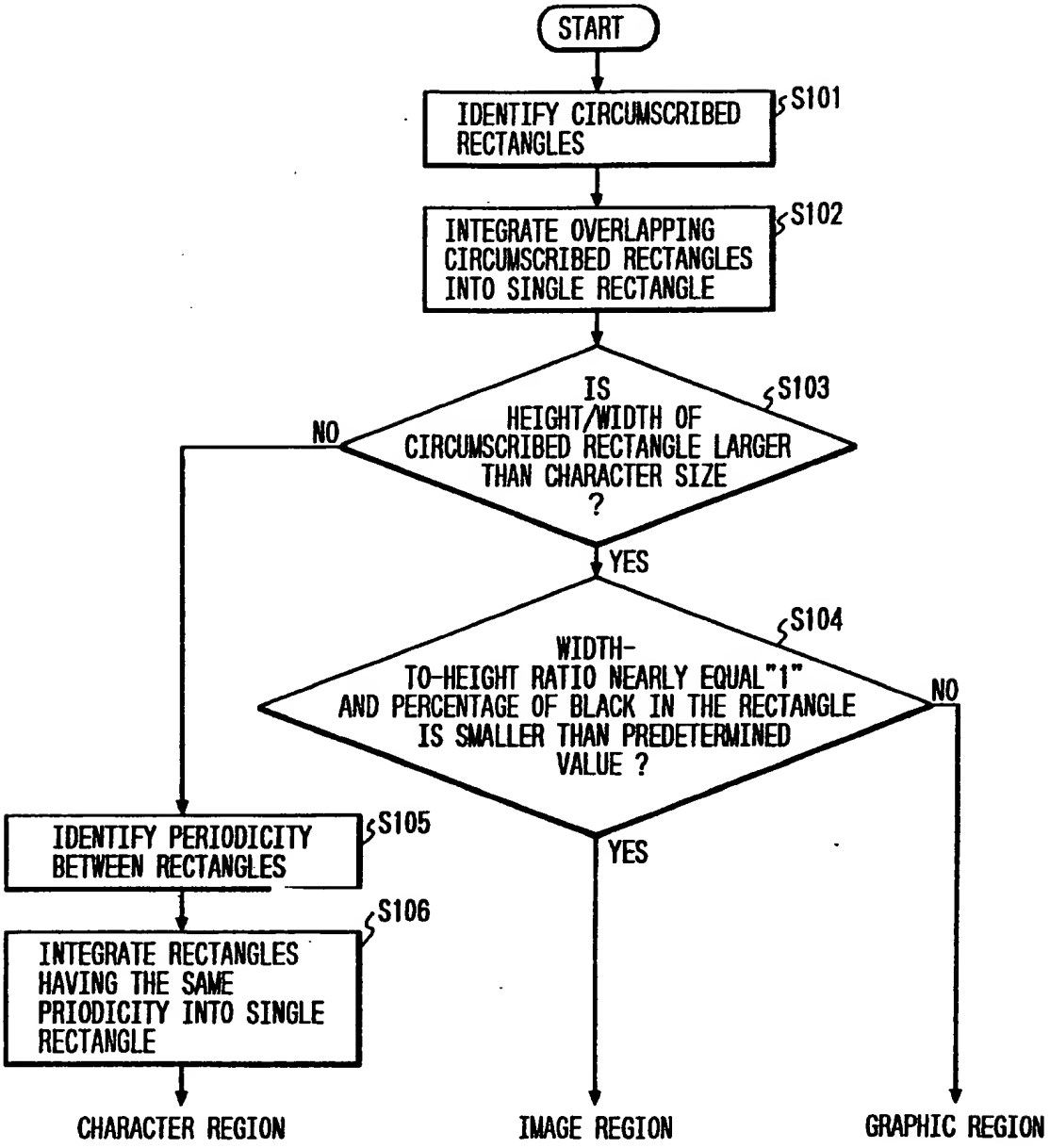

START
IDENTIFY CIRCUMSCRIBED RECTANGLES
S101
INTEGRATE OVERLAPPING CIRCUMSCRIBED RECTANGLES INTO SINGLE RECTANGLE
S102
IS HEIGHT/WIDTH OF CIRCUMSCRIBED RECTANGLE LARGER THAN CHARACTER SIZE ?
S103
NO
YES
WIDTH-TO-HEIGHT RATIO NEARLY EQUAL "1" AND PERCENTAGE OF BLACK IN THE RECTANGLE IS SMALLER THAN PREDETERMINED VALUE ?
S104
NO
YES
IDENTIFY PERIODICITY BETWEEN RECTANGLES
S105
INTEGRATE RECTANGLES HAVING THE SAME PRIODICITY INTO SINGLE RECTANGLE
S106
CHARACTER REGION
IMAGE REGION
GRAPHIC REGION

FIG. 4

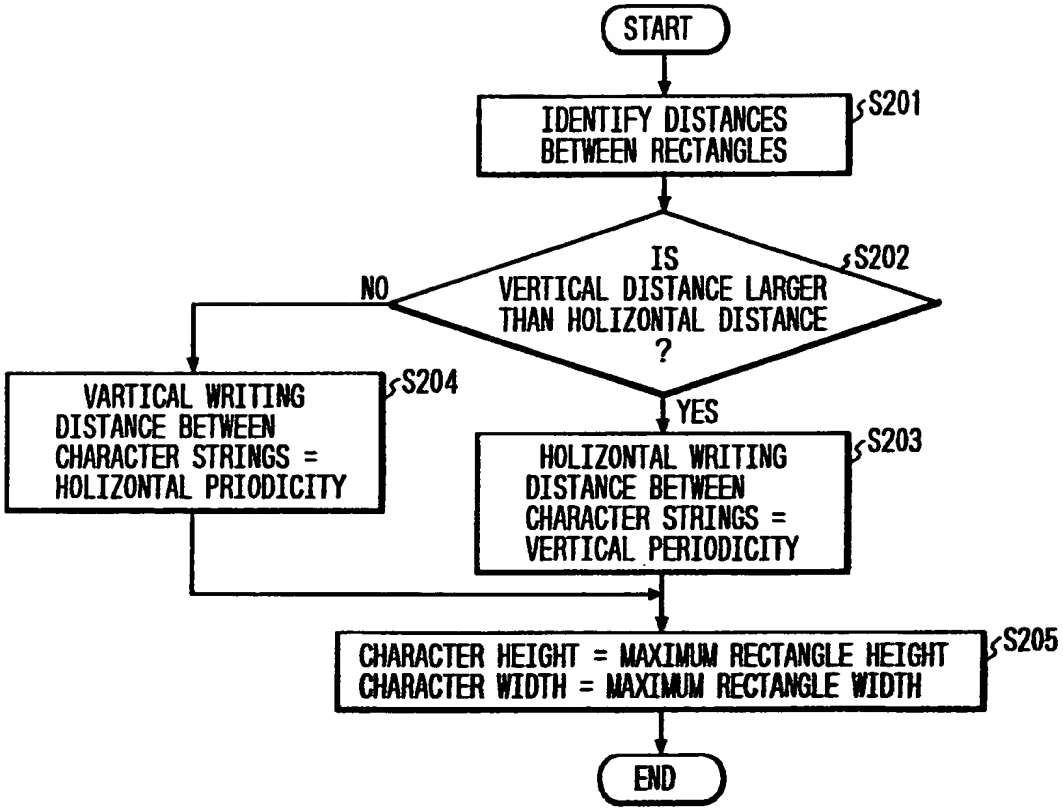

START
IDENTIFY DISTANCES BETWEEN RECTANGLES
S201
IS VERTICAL DISTANCE LARGER THAN HOLIZONTAL DISTANCE ?
S202
NO
YES
VARTICAL WRITING DISTANCE BETWEEN CHARACTER STRINGS = HOLIZONTAL PRIODICITY
S204
HOLIZONTAL WRITING DISTANCE BETWEEN CHARACTER STRINGS = VERTICAL PERIODICITY
S203
CHARACTER HEIGHT = MAXIMUM RECTANGLE HEIGHT
CHARACTER WIDTH = MAXIMUM RECTANGLE WIDTH
S205
END

FIG. 5

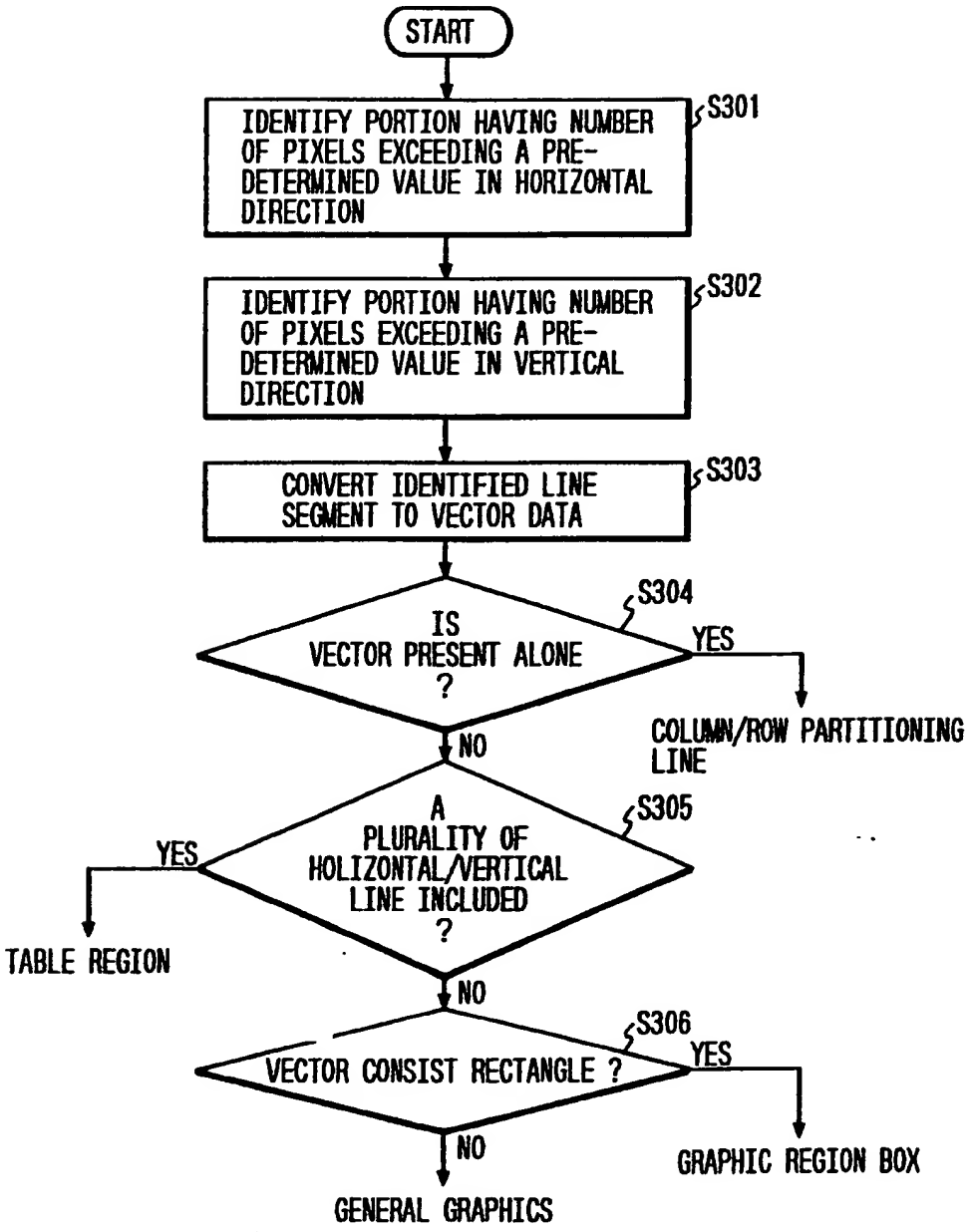

START
IDENTIFY PORTION HAVING NUMBER OF PIXELS EXCEEDING A PRE-DETERMINED VALUE IN HORIZONTAL DIRECTION
S301
IDENTIFY PORTION HAVING NUMBER OF PIXELS EXCEEDING A PRE-DETERMINED VALUE IN VERTICAL DIRECTION
S302
CONVERT IDENTIFIED LINE SEGMENT TO VECTOR DATA
S303
IS VECTOR PRESENT ALONE ?
S304
YES
COLUMN/ROW PARTITIONING LINE
NO
A PLURALITY OF HOLIZONTAL/VERTICAL LINE INCLUDED ?
S305
YES
TABLE REGION
NO
VECTOR CONSIST RECTANGLE ?
S306
YES
GRAPHIC REGION BOX
NO
GENERAL GRAPHICS

FIG. 6A

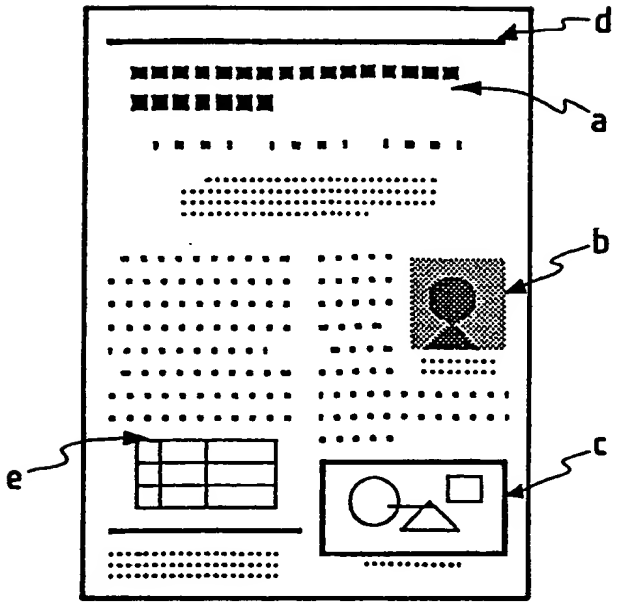
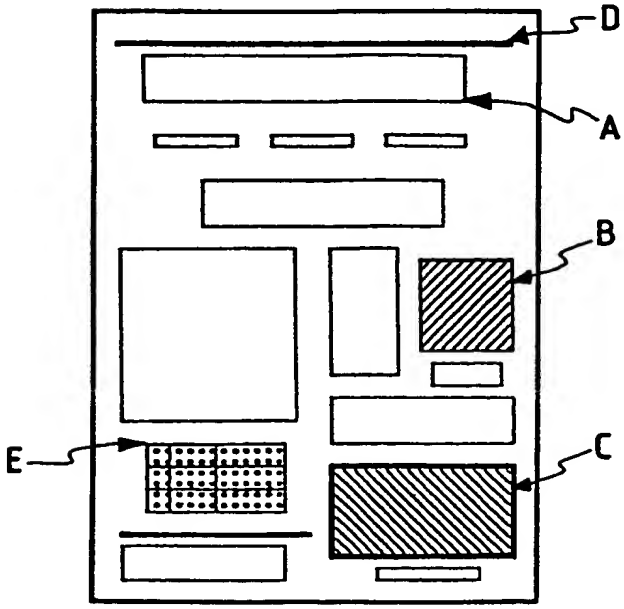


FIG. 6B



DOCUMENT CREATION AID.

The present invention relates to a document creation aid. Such an aid may be suitable for use with word processors and workstations. The document creation aid can be used for electronically producing document layouts of a complicated pattern in which heterogeneous data such as characters, graphics, and images are mingled.

In creating documents using document creating devices such as word processors and workstations, it is sometimes desired that different types of data are included within a document, e.g. characters; graphics represented by vector data such as straight lines and curved lines; and bit map images specified by bit patterns such as images read by image readers. To create documents having heterogeneous data including characters, vector-expressed graphics, and bit map images, the data processing mode differs from one type of data to another within the document creating device. To improve processing efficiency under such circumstances, boxes such as a character box, a graphic box, and an image box are defined in a document and, when creating or editing the document, the attributes of each processing box are judged and the box is processed in accordance with the judged attributes. Throughout this specification, according to the context, the term "image" is to be broadly construed as including characters, vector-expressed graphics, bit map images, and the like, and narrowly construed as indicating only bit map images.

In order to create a document having a mixture of characters, vector-represented graphics, bit map images, and the like using the conventional document creating devices, the document creator has to specify the boxes

corresponding to the attributes in the document and adjust their sizes and positions.

However, such box specification and adjustment operations must be performed for each type of box, i.e. the character box, the graphic box, and the image box. In addition, when there exists a plurality of boxes defined by the same attribute, the same operation must be repeated. This has made the conventional document creating operation cumbersome and time-consuming. Particularly, when an analogous document exists and it is desired that the same layout as that of the analogous document be used, the above input operations must be followed one by one, requiring the user to spend time recreating the layout of the document.

One technique to reduce layout preparation time is to prepare a plurality of types of documents, each having a standard layout, in advance and to search and copy a document having the desired layout, and enter the desired data into that document whenever necessary.

With this technique, however, all the standard layouts must be pre-stored, requiring a labour intensive initial set up operation. In addition, documents with all the standard layouts must be stored, which demands an enormously large storage capacity. Further, to use the stored layouts, the operation of searching for the target layout must always be involved. If the number of stored layouts is large, such searching operation is not an easy job.

According to a first aspect of the invention, there is provided a document creation aid as defined in the appended Claim 1.

According to a second aspect of the invention, there is provided a document creation aid and as defined in the appended Claim 2.

According to a third aspect of the invention, there is provided a method as defined in the appended Claim 4.

Preferred embodiments of the invention are defined in the other appended claims.

It is thus possible to provide a document creation aid which can generate various types of layouts with attribute boxes automatically when there are documents whose layouts serve as models for the layouts of documents to be created, thereby improving document creation efficiency.

In a preferred embodiment, a document serving as a model is read and the regions in the read image are identified by the layout analysis section when a layout of the document is to be specified. For example, the circumscribed rectangles of some coupled images included in the document are identified, and whether each circumscribed rectangle is a character region, a graphic region, or an image region is judged by the size, position, and the like of the circumscribed rectangle. Then, the corresponding regions are specified to a document to be newly created based on these analyzed regions by instructions from the layout generation instruction section. Accordingly, the newly created document has the respective regions set with the same layout as that of the model.

The invention will be further described, by way of example, with reference to the accompanying drawings, in

which:

Figure 1 is a block diagram showing the configuration of a document creating device including a document creation assist device constituting an embodiment of the invention;

Figure 2 is a block diagram showing a configuration of a layout analysis section;

Figure 3 is a flow chart showing an example of a procedure for region analysis;

Figure 4 is a flow chart showing an example of a procedure for character portion analysis;

Figure 5 is a flow chart showing an example of a procedure for graphic portion analysis; and

Figures 6A and 6B are diagrams schematically illustrating examples of document images and an example of a layout analysis.

Figure 1 shows the configuration of a document creating device, such as a word processor including a document creation assist system. A document creation assist device 1 includes: an image input section 2 which reads a document as an image; a layout analysis section 3 which defines a document layout based on the images read from the document; and a layout generation instruction section 4 which instructs generation of graphic boxes, character boxes, image boxes, or the like in accordance with the analyzed layout. The layout specified by the layout generation instruction section 4 is represented by a layout casting section 5 so that the user can see the

layout. Data entered from a keyboard/mouse 6 are converted to characters and graphics by a character/graphic input section 7, entered into each box which has already been laid out by a content casting section 8, and displayed by a display section 9. When the layout is input manually from the keyboard/mouse 6, a layout co-ordinate/attribute input section 10 converts the data from the keyboard/mouse 6 and the converted data are sent to the layout generation instruction section 4.

Figure 2 shows a configuration of the layout analysis section 3. The images read from the document by the image input section 2 are divided into regions such as a character region, a vector-represented graphic region, and a bit map image region. In the character region, data (character box/character portion attribute data) such as the position of the character region, the size of characters, the distance between character strings, and the direction of the character strings are identified by a character portion analysis section 12. In the graphic region, data such as the outer frame of a graphic, the frame of a table, ruled lines and column/row partitioning lines of tables are detected and output as vector data (graphic box/line data). In the image region, data are produced as box data.

The operation of the layout analysis section 3 will be described next.

The document images serving as a model layout are input by the image input section 2 (see Figure 1), and the document images represented in binary-coded form are analyzed by a region analysis section 11. Although region analysis techniques are not particularly limited, one example of such a technique identifies circumscribed

rectangles, each enclosing images which are coupled to one another therein, and classifies each rectangle by the size, position, and the like.

Figure 3 shows an example of a procedure for a region analysis.

Circumscribed rectangles are identified (Step S101). Any overlapping circumscribed rectangles are integrated into a single circumscribed rectangle which incorporates all such overlapping circumscribed rectangles (Step S102). Those circumscribed rectangles whose vertical or horizontal length exceeds the size of a character can be identified as a bit map image or a vector-represented graphic (Step S103). For example, if characters of up to 36 point in size are used, any circumscribed rectangle whose height or width is larger than about 13 mm is judged to be a bit map image or a vector-represented graphic. If a circumscribed rectangle, among large circumscribed rectangles, satisfies the conditions that its height-to-width ratio is close to 1, for example between 1/3 and 3, and the percentage of black pixels contained therein is relatively high, then it can be identified as an image region (Step S104). Other large circumscribed rectangles can be deemed as graphic regions. Small circumscribed rectangles are judged to be characters, and this can be verified by checking the periodicity of the characters in their horizontal and vertical directions (Step S105). A set of circumscribed rectangles whose character periodicity in both the horizontal and vertical directions is substantially constant is identified as a group of characters having the same attribute, i.e. as a character region (Step S106). The above processing identifies character regions, graphic regions, and image regions, and provides

data about the size and position of each region.

While each region is identified by the size and height-to-width ratio of each circumscribed rectangle in the above region analysis, other analysis techniques may be applicable, for example an algorithm merging both a marginal distribution method and a black points concatenation method such as disclosed in "Automatic Document Recognition System" (Kida et al), or "Image Electronics Society Journal" (Vol.15 No.2, 1986, pp.107-115).

The character portion analysis section 12 will be described next. The section 12 analyses the pattern of regions identified as character regions by the region analysis section 11. Analysis techniques are not particularly limited with this section 11. One technique is to utilise the previously identified circumscribed rectangles and their periodicity. Figure 4 outlines an example of a procedure thereof.

The direction of a character string is first detected. The distance between characters in a character string is usually smaller than that between character strings. First, the distances between circumscribed rectangles are identified (Step S201), and the direction, either horizontal or vertical, in which the average distance between the circumscribed rectangles is smaller is judged as the direction in which the characters are arranged (Step S202). That is, when the distance in the vertical direction is larger than that in the horizontal direction, it is judged that the characters are written horizontally and thus the distance between the character strings is identified as having a vertical periodicity (Step S203). Otherwise, it is judged that the characters

are written vertically and thus the distance between the character strings is identified as having a horizontal periodicity (Step S204).

The size of a character is then calculated from the maximum values of the height and width of each circumscribed rectangle in the region (Step S205). As a result of the above processing, the attributes within each character region can be identified.

The graphic portion analysis section 13 analyzes the regions judged as graphic regions by the region analysis section 11 and represents the line drawings therein in terms of vectors. Although it is possible to express all the detected line drawings in vectors, only long straight line segments, both horizontal and vertical, which can be considered as being important and thus repetitively usable in terms of a pattern of layout are identified. These line segments include: frame data, ruled lines, table forming frames consisting of vertical and horizontal straight lines, and column/row partitioning lines.

Figure 5 shows an example of a procedure for the graphic portion analysis.

One technique of identifying horizontal and vertical lines is such that black pixels are traced substantially horizontally and substantially vertically and that those exceeding predetermined length are selected (Steps S301, S302). The obtained horizontal and vertical lines are converted to vector data represented by data such as the start point/end point data and the width (Step S303). Among these vector-represented lines, any single line segment which stays alone or away from the others is

judged as a row or a column partitioning line dependent upon orientation (Step S304). A portion comprised of a combination of a plurality of horizontal and vertical lines is judged as part of a table (Step S305), while a portion formed by a single rectangle with horizontal and vertical lines is deemed to be a graphic box (Step S306). Otherwise, the portions are considered as general graphics.

The layout analysis is completed with the above processing, and the document images read by the image input section 2 are broken down into the character region, the image region, and the graphic region. The graphic region includes tables and lines. The character region additionally includes attributes such as the character size, the distance between the character strings, and the direction of the character strings. The layout generation instruction section 4 shown in Figure 1 instructs layout casting based on the above data to the layout casting section 5, so that the each region can be arranged as instructed.

For example, if a document serving as a model including a character portion a, a bit map image portion b, a graphic portion c, a partitioning line d, and a table e as shown in Figure 6A is read by the image input section 2, then a layout analysis on this document generates a layout which is schematically shown in Figure 6B. In Figure 6B, reference character A designates a character region; B, an image region; C, a graphic region; D, a partitioning line; and E, a table structure. Since the respective regions identified by the layout analysis have been displayed on a screen of the display section 9, the user then specifies a region into which characters or graphics are entered via the keyboard/mouse 6. Thus, the user

only has the operation of inputting the desired data into the corresponding regions via the keyboard/mouse 6 to create a document having the desired layout.

To insert a bit map image directly into a document, the image data input from the image input section 2 may be sent to the content casting section 8 for its synthesis with the document.

The user may edit the layout of the respective regions generated by the layout analysis as desired, and the contents may be laid out in the edited regions.

While document creation is taken as an example of use of the document creation aid, it has other uses such as in the creation of pre-formatted documents, such as a slip.

While, for tables, only the vertical and horizontal lines are reproduced based on the vector data obtained by the analysis in the above embodiment, data that indicate attributes such as rows and columns of tables may be output instead of vector data if the document creating device can generate and manage table structures.

While the data identified in a character portion only are the size of characters, the distance between character strings, and the writing style, either vertical or horizontal, in the above embodiment, data such as the difference in calligraphic style or the difference in language, e.g. Japanese or English, may be identified and included as additional attributes.

By arranging for respective characters to be recognised in a character region and for respective graphics to be recognised in a graphic region, then not only the layout

data but also its contents can be re-usable.

It is thus possible to generate a layout automatically based on the images read from a document. Therefore, when creating a document having an analogous layout, the user does not have to perform region setting and revising operations at all, or at least such operations are reduced into simpler ones, thereby improving document creation efficiency. In addition, it is no longer required to prepare or store documents with standard layouts in advance, thereby dispensing not only with the preparatory labour but also with a large capacity storage unit.

CLAIMS

1. A document creation aid, comprising:

image input means for reading an image of a first document serving as a model;

layout analysis means for analyzing the image of the first document and for identifying the layout of the first document in respect of the position, size and at least one attribute of at least one region included within the first document; and

layout generation instruction means for instructing regions to be set in a second document so that the layout of the second document is a substantial copy of the layout of the first document.

2. A document creation assist device for use in a document creating device which, when a document is created, defines regions which are different from one another in accordance with attributes of images included in said document and processes each of said regions differently, said document creation assist device comprising:

an image input section for reading said document serving as a model as an image;

a layout analysis section for judging attributes of said images read from said document and identifying layout data indicating the size, position, and attribute of each of said regions based on differences in said judged attributes; and

a layout generation instruction section for instructing to set the same regions as those of said document serving as a model to a document to be created based on said identified layout data.

3. A document creation assist device according to

Claim 2, wherein said layout analysis section includes:

a region analysis section for identifying a character region, a graphic region, and an image region from said images of said document;

a character portion analysis section for analyzing an attribute of a character portion within said character region; and

a graphic portion analysis section for identifying a line component within a graphic by analyzing a graphic portion within said graphic region and outputting said line component as vector data.

4. A method of formatting a second document from a first document, comprising the steps of analyzing an image of the first document to determine the relative size, relative position and at least one attribute of at least one region of the first document, and generating instructions for the layout of the second document such that the second document has substantially the same layout as that of the first document.

5. A document creation aid substantially as hereinbefore described with reference to and as illustrated in the accompanying drawings.

6. A method of formatting a document substantially as hereinbefore described with reference to the accompanying drawings.

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